Space Weather Technical Forecast

Issued on Friday 25 October 2024 at 01:32 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-flares likely, slight chance of further X-flares. Chance G1-G2/Minor-Moderate geomagnetic storm intervals days 2 and 3 (26/27 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High with peak isolated flare X3.3 at 24/0357 UTC from the vicinity of AR3869 in the southeast disc. There are currently around ten regions on the visible disc. The main regions of interest are a collection of potentially complex and interconnected sunspot regions close to the southeast limb. While currently difficult to assess, these are accompanied by areas of brightness and complex looping evident on SDO AIA-94 and AIA-171 imagery respectively.

The strong X3.3 flare produced a CME that has been assessed as a likely miss, passing behind Earth, though some Earth-directed component is possible from shock possibly arriving 26 or 27 Oct.

Solar Wind / Geomagnetic Activity: Solar winds were generally indicative of background conditions. Speeds, observed by ACE at L1, were slow-ambient, falling from 370 to 320 km/s. Density was around average or below. The Interplanetary Magnetic Field (IMF) remained mostly weak, on a declining trend, falling form 8nT to 2-4nT. The north-south component was mostly negative (southward), fluctuating weakly between -7nT and +3nT. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3), but with an Active interval (Kp 4) 24/0600-0900 UTC.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background levels, with a very slight enhancement above baseline after the X3.3 flare. High energy electron flux (greater than 2MeV) observed by GOES16 remained at background. The associated 24-hour fluence was well below the Active threshold, with 1.55e6 integrated flux observed at 25/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate is expected, with M-class flares considered likely and a slight chance of further X-class flares.

Solar Wind / Geomagnetic Activity: The are no Earth-directed CMEs, but two or three CMEs which may give shock or glancing impacts day 2 or day 3 (26/27 Oct). Solar winds are currently at background levels. Winds are expected to remain at largely background levels until day 2 (26 Oct)

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with fast winds from CH84/- peaking at slightly elevated or elevated speeds before waning during day 3 (27 Oct).

Activity is expected to be largely Quiet to Unsettled (Kp 1-3) to start. The combined onset of any enhancement from CH84/-, and the influence of any shock or glancing CME impacts brings a chance of G1-G2/Minor-Moderate geomagnetic storms (Kp5-6) during day 2 (26 Oct) or early day 3 (27 Oct) before easing into day 4 (28 Oct).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to remain at background. High energy electron flux at GOES16 is forecast to remain at mainly background, with the associated 24 hour fluence remaining well below Active.

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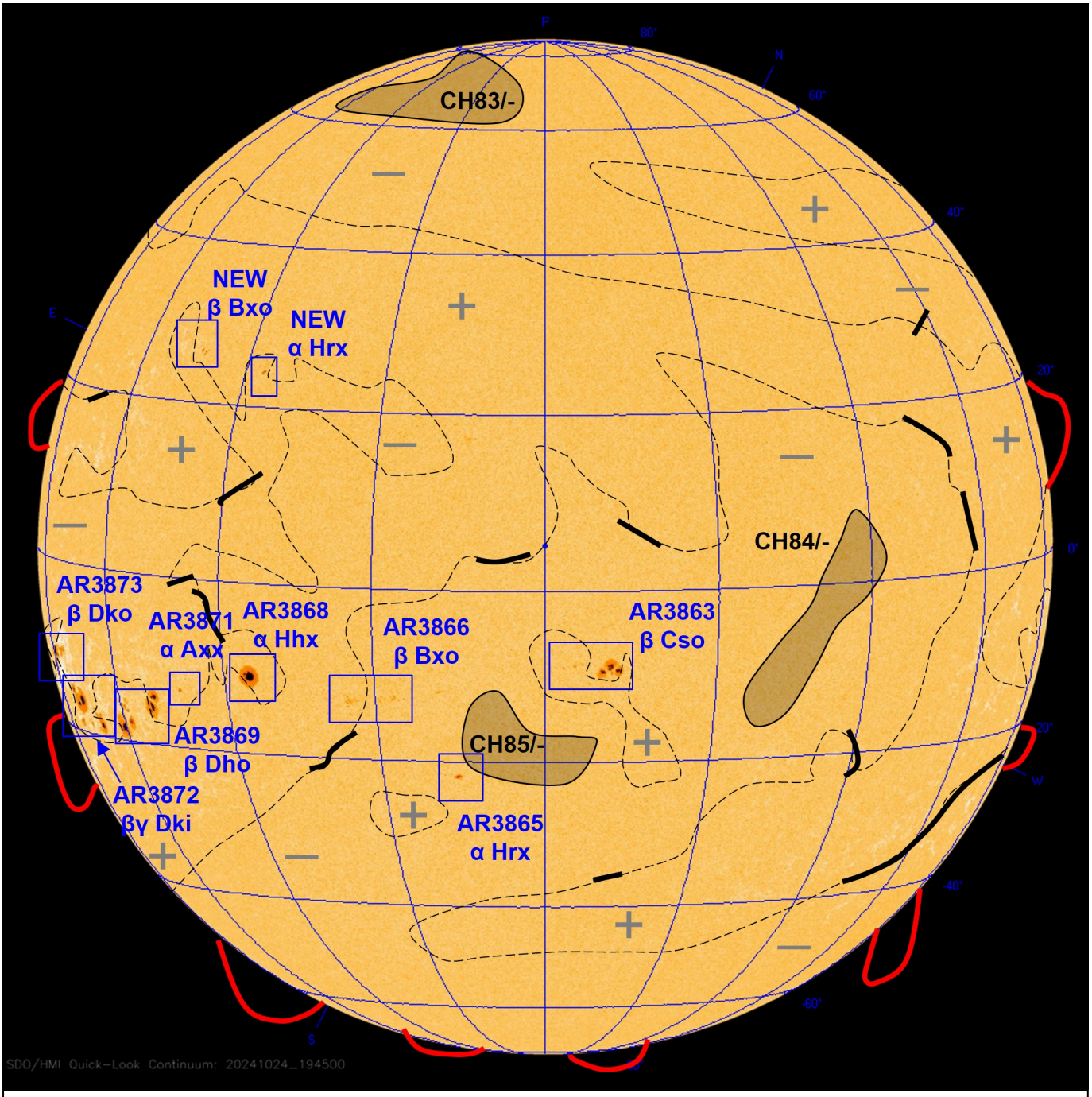
Figure 1: Solar synoptic map valid 24/1945 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

The are no Earth-directed CMEs. A number of weak CMEs from 23 Oct have been modelled to miss Earth, although there remains an element of uncertainty in the nature of the CME observed around 23/1230UTC and the potential for an Earth-directed component and glancing blow on 26 Oct. The main CME of note for the forecast period is from the X3.3 flare at 24/0357 UTC. This CME originated from close to the southeast limb, with the bulk of ejecta expected to pass to the south of Earth. However, there remains the possibility of a glancing blow from shock during 26 or 27 Oct which may sweep up the previously mentioned CME.

Solar winds are currently at background levels. Winds are expected to remain at largely background levels until day 2 (26 Oct) with fast winds from CH84/- peaking at slightly elevated or elevated speeds before waning during 27 Oct. Enlil wind speed projections are considered reasonable if not a little late, with SWPM supporting similar peak values.

Activity is expected to be largely Quiet to Unsettled (Kp 1-3) to start. The combined onset of any enhancement from CH84/-, and the influence of any shock or glancing CME impacts brings a chance of G1-G2/Minor-Moderate geomagnetic storms (Kp5-6) during day 2 (26 Oct) or early day 3 (27 Oct) before easing into day 4 (28 Oct).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	40	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: MOSWOC ENLIL

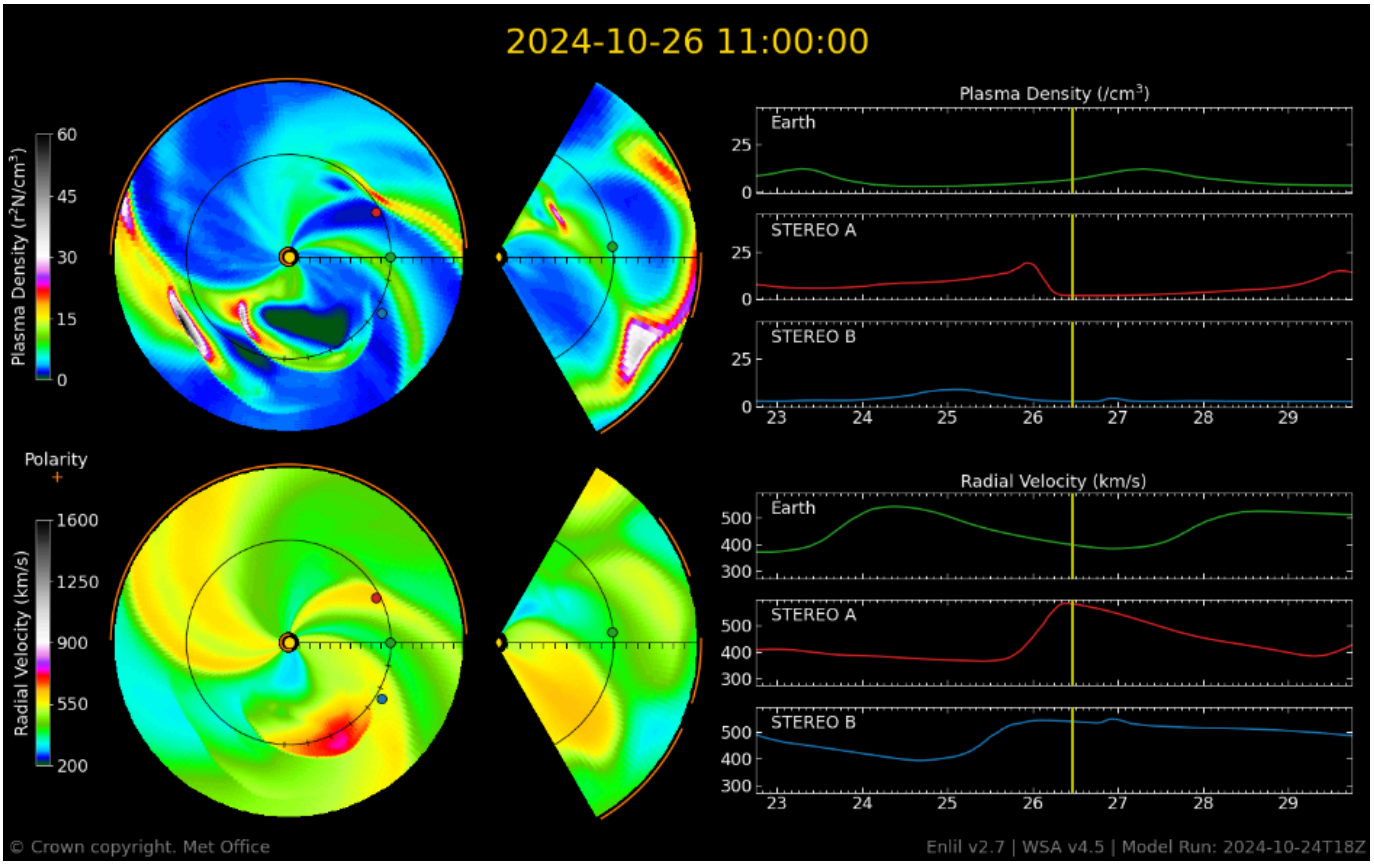
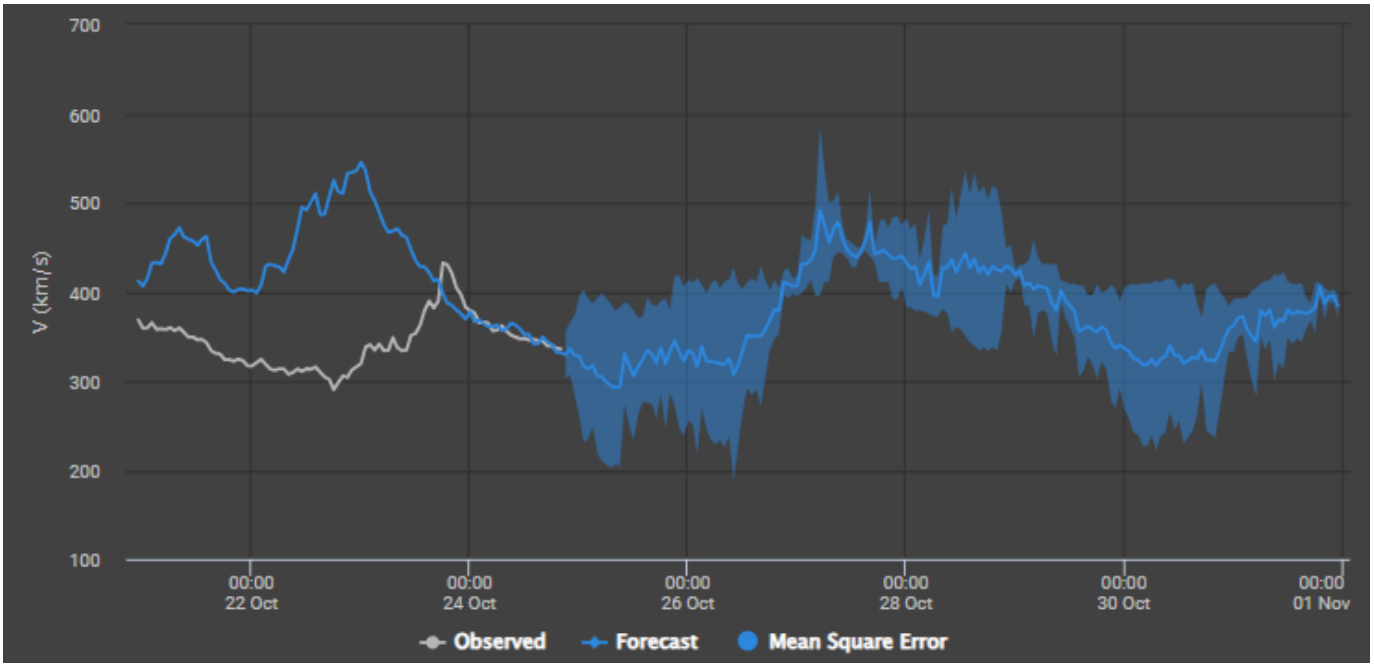


Figure 3: MOSWOC SWPM



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Radio Blackouts - X-Ray Flares

Solar activity has been High with a single X3.3 flare at 24/0357 UTC, the source of which was close to AR3869 and AR3872 near the southeast limb. Activity has then since slowly declined to C-class levels with no further flares observed.

There are currently eight numbered and two unnumbered spots on the disk. Much of the focus is toward the southeast of the disk, with at least two large and significant regions in residence here. These have been numbered AR3869 and AR3872, the former leading the latter, both of which appear to comprise mature penumbra around both leading and trailing regions, each with modest magnetic complexity, but their proximity to each other leading to magnetic looping evident between both spots and an overall complexity greater than the sum of their individual parts. AR3873 to the northeast of the aforementioned regions appears to be a moderately sized and perhaps complex region, with a elongated asymmetric trailing spot, though foreshortening effects are making clear analysis of the magnetic fields of any of these three spots difficult at present. Most other regions on the disk are smaller or simple and exhibit little signs of change.

Low to Moderate activity is generally expected with M-flares likely and a slight chance of further isolated X-flares. These are most likely from the regions in the southeastern disc.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

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Figure 4: 24 hour X-ray trace.

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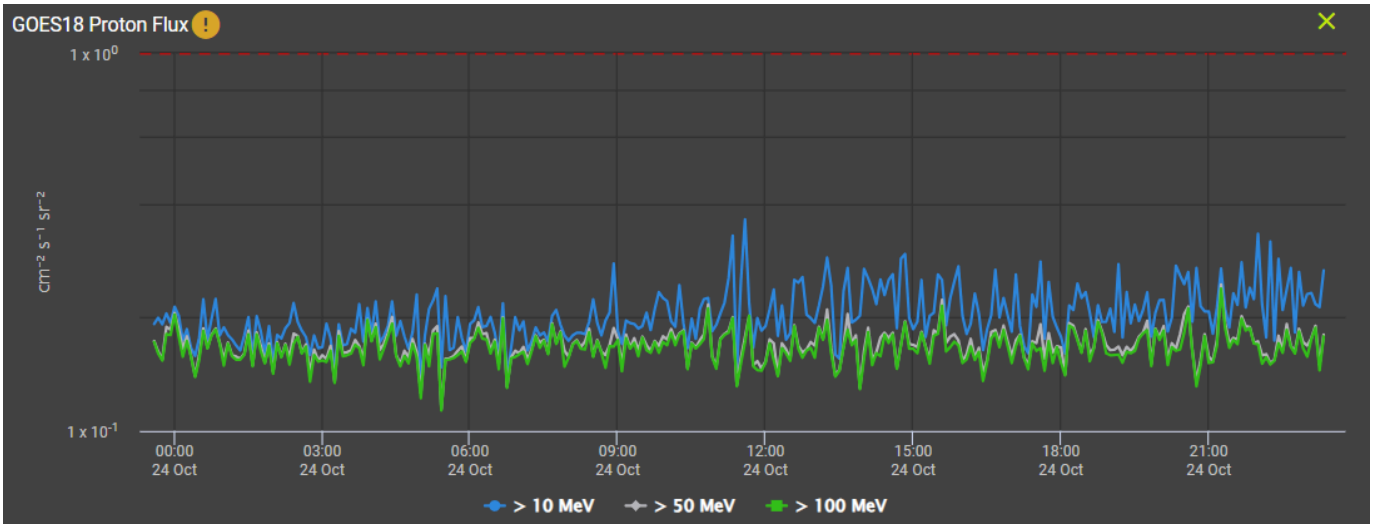
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is forecast to remain at background, although some slight proton enhancement is possible should further significant flares occur. The current most active regions located near the east limb, with these gradually transiting toward centre disk by the end of the period allowing a greater risk of proton enhancements.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: 24 hour proton trace



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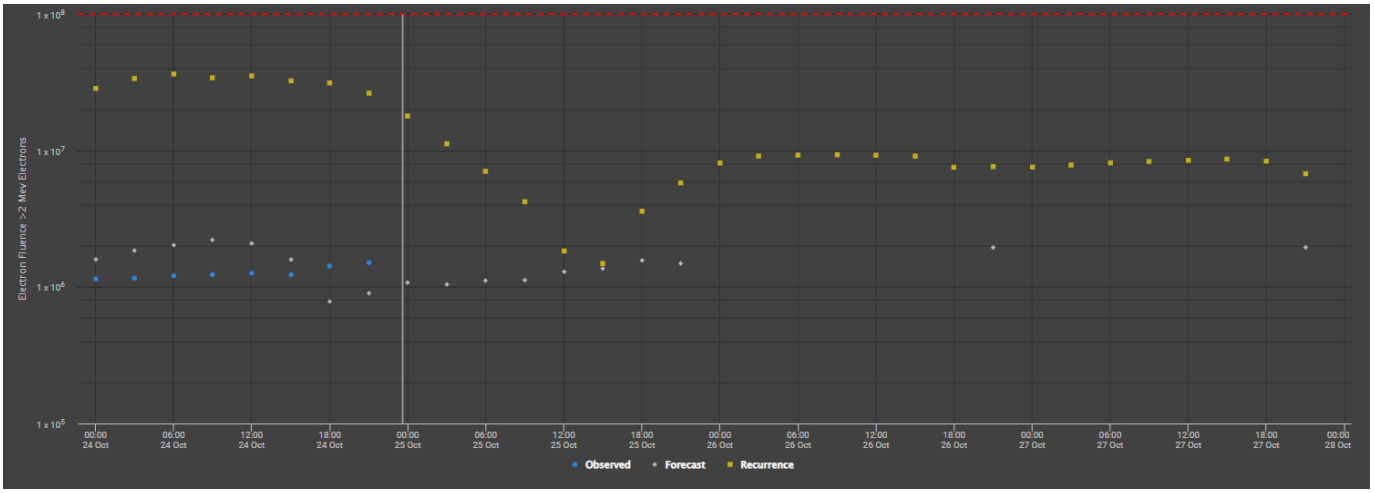
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background, and is expected to persist mainly at this level with no significant enhancements expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with MOSWOC REFM providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 6: MOSWOC REFM



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